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GB A 2050995	GB 1576116	

(58) Field of search
B8E
Selected US specifications from IPC sub-classes B67D E21B

(54) Off-shore loading arrangement

(57) An off-shore loading arrangement for loading material, such as oil, gas, minerals or the like, from the sea or sea bed to a floating structure (30), such as a tanker, a barge. The arrangement comprises a loading device (10) separate from the floating structure (30), to which device the material to be loaded is transported from a collecting means (25), located on the sea bed or in the sea, along a flexible transportation means (20). The loading device (10) is provided with supporting and attachment means (15, 16, 40, 42, 44) for attaching the loading device (10) to, and outwardly of, the floating structure (30) during the material loading phase. The attachment provides a substantially rigid and immovable connection. A connection unit (11) is rotatable in bearings (12) and the device may be raised and lowered using ballast tanks (14). Piping (13) conveys the material from unit (11) to a fitting (31) on the structure (30). The device may be U-shaped, L -shaped or flat in cross section, and if U-shaped one arm may be pivotable on the base of the U. The device may be capable of floating, or may be raised by the structure to engage therewith.

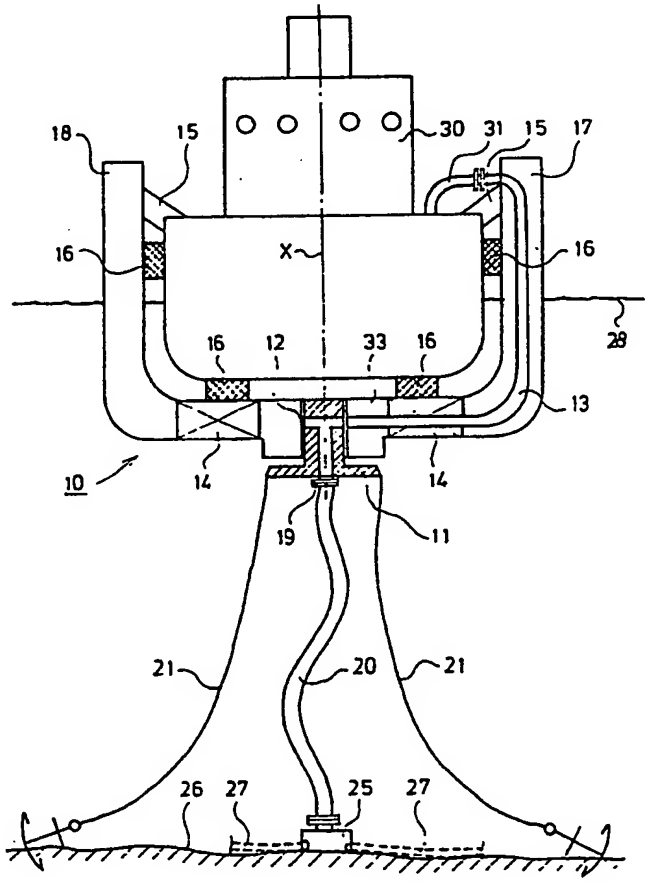

FIG.1

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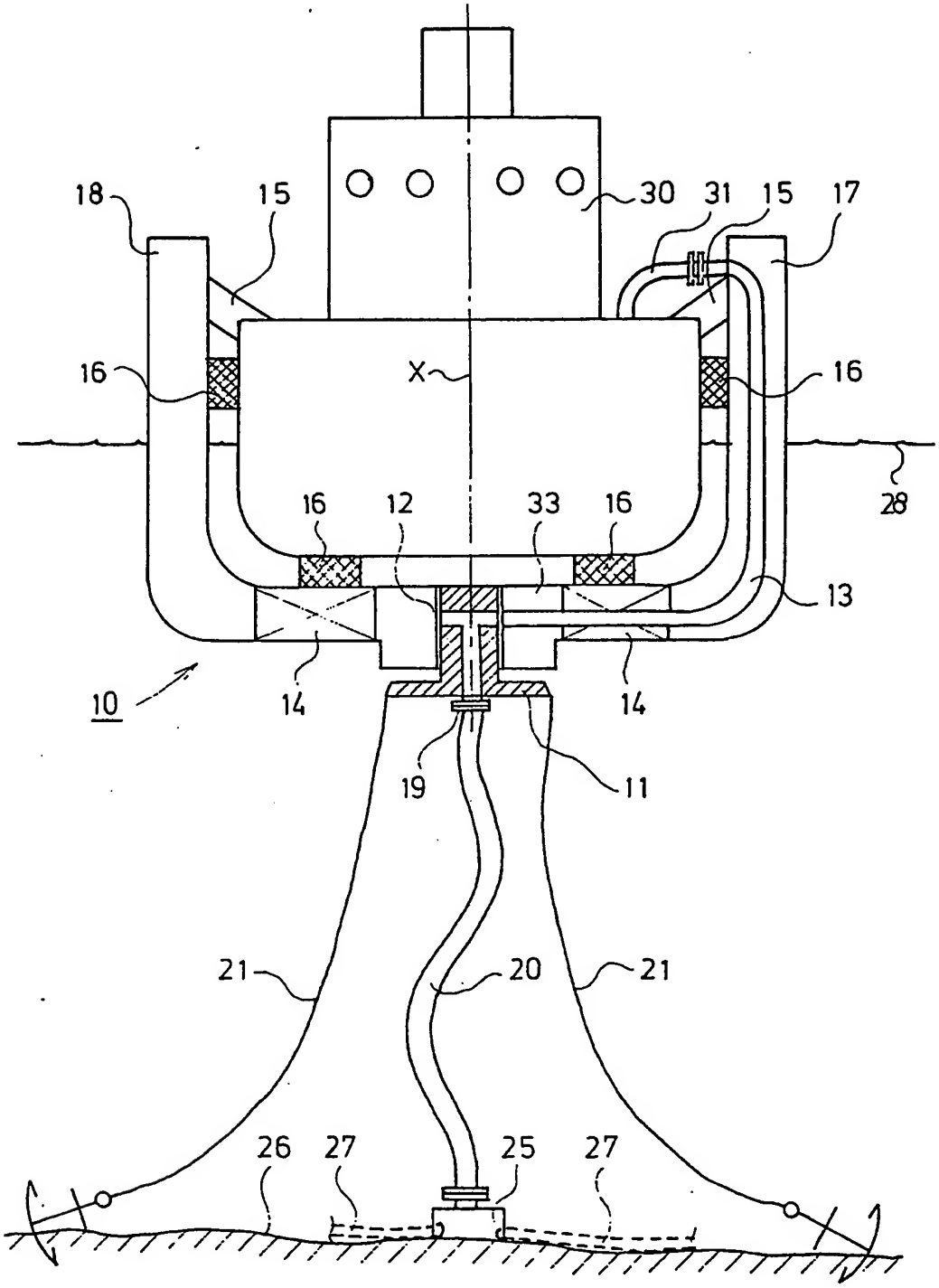
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FIG.1

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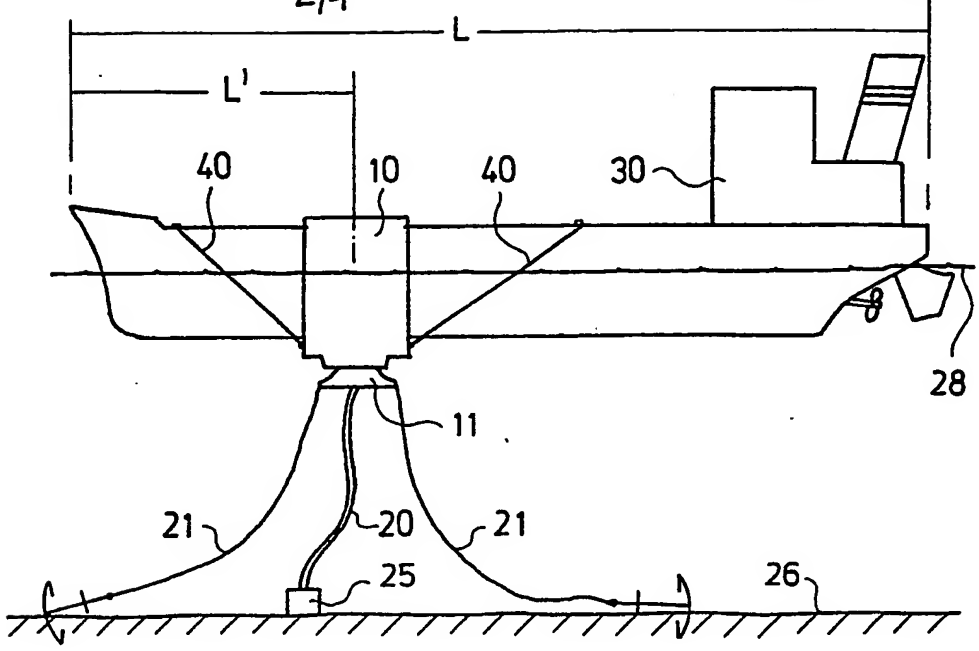

FIG. 2

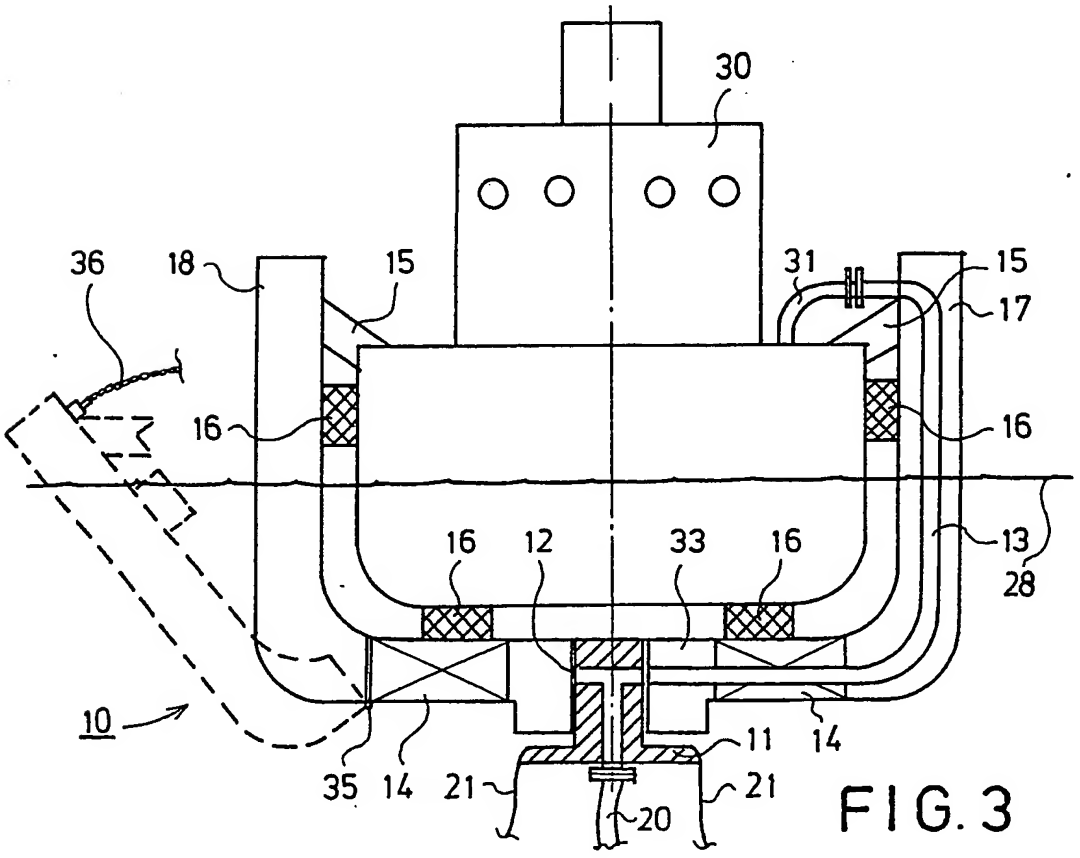

FIG. 3

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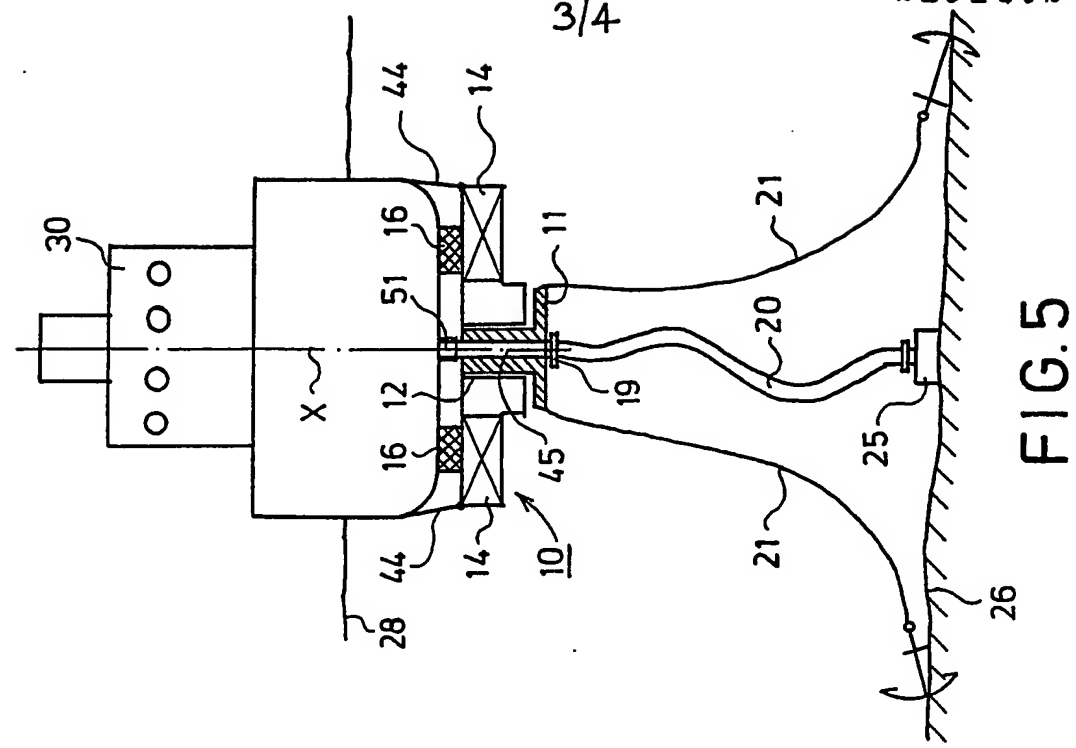

FIG. 5

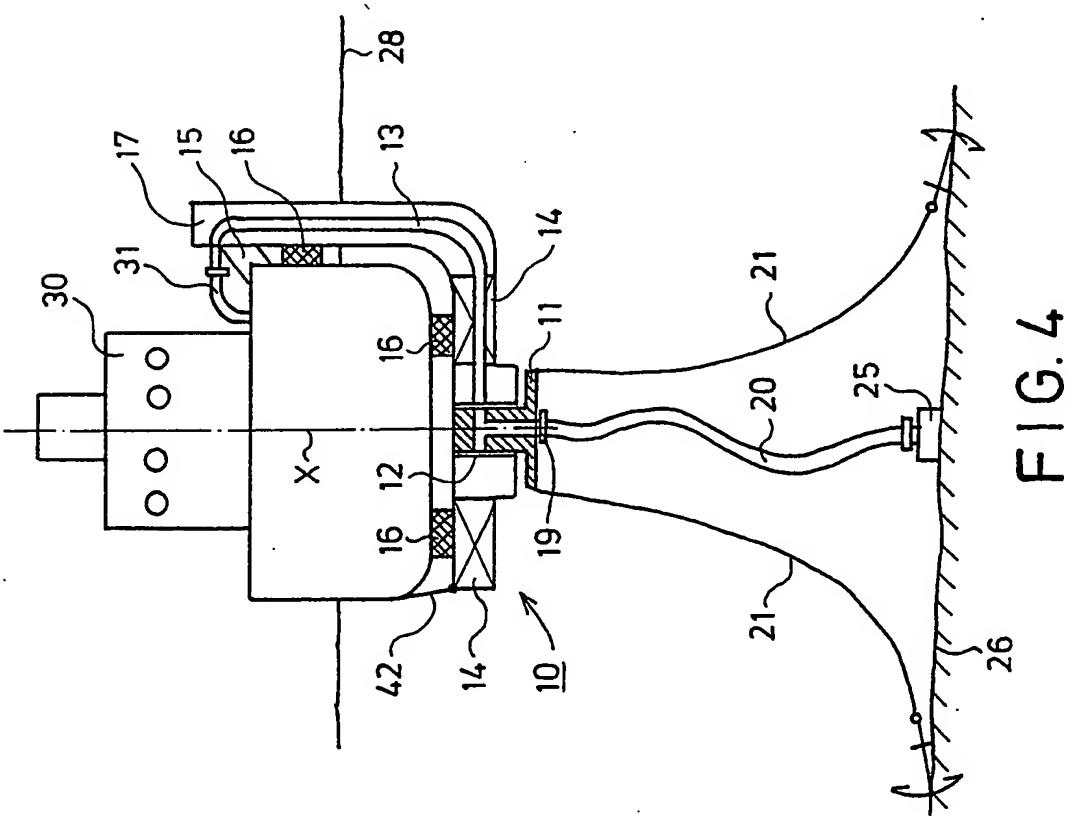

FIG. 4

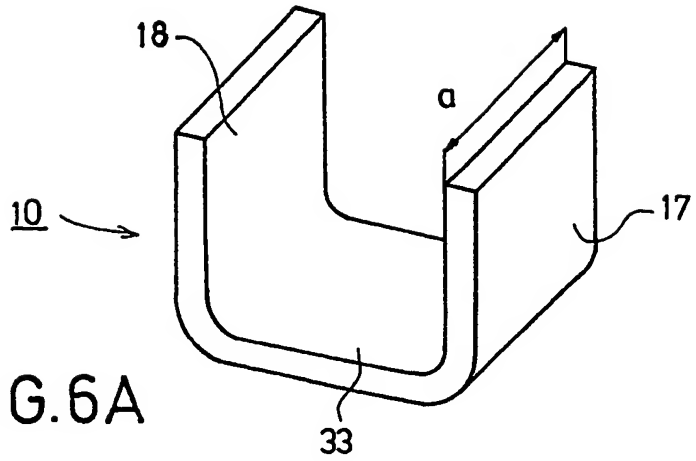

FIG.6A

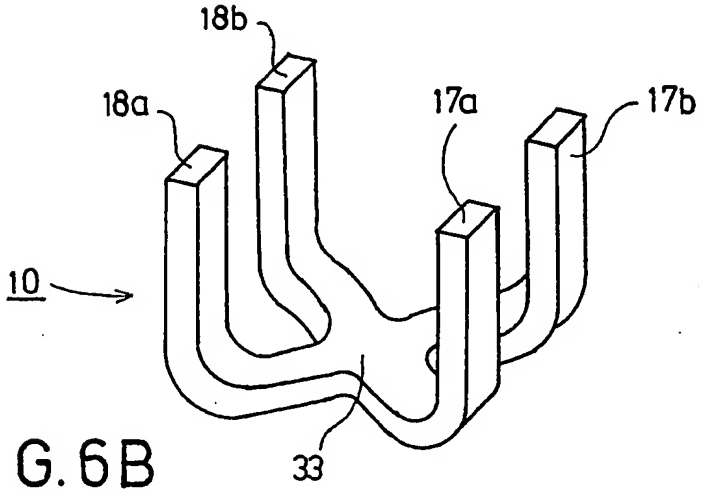

FIG.6B

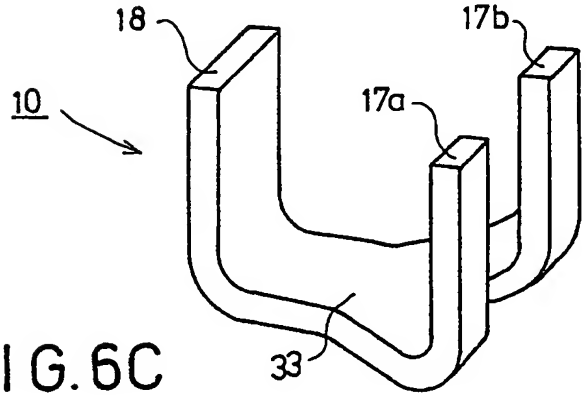

FIG.6C

SPECIFICATION

Loading arrangement

This invention relates to a loading arrangement of the kind intended for use in off-shore locations to load materials, such as oil, gas, minerals or the like, from the sea or sea bed to a floating structure, such as a tanker, a barge or the like, which loading arrangement comprises a loading device, separate from the floating structure, to which the material to be loaded is arranged to be transported from a collecting or storage means, e.g. a collecting place, a storage tank or the like, located in, or at the bottom of, the sea along a flexible transport element, such as a piping, a conveyor or the like, and from which loading device the material to be loaded is further arranged to be transported into the floating structure.

A loading arrangement according to the invention is especially intended for use in such off-shore regions in which the swell of the sea or ocean may be relatively heavy and in which regions the yield of materials to be loaded may be marginal, so that it does not pay to build fixed loading arrangements in the region. A loading arrangement according to the invention is especially favourable in marginal gas and oil fields, in which the utilisation of conventional production platforms would raise the level of the production costs too much. For this purpose, there has previously been developed several different solutions, which, however, comprise many drawbacks.

A conventional solution for pumping oil or gas from oil or gas fields beneath the sea is to arrange a collecting place or a storage tank on the bottom of the sea, to which collecting place or tank oil or gas is lead from different parts of the oil or gas field, for example, by means of pipes arranged along the sea bed. Valve elements are arranged at the collecting place and from the collecting place the oil or gas in them lead, for example, to a loading buoy and from the loading buoy further to a tanker or a barge, which may be equipped with means for the transportation, storage or processing of the collected oil or gas. The loading buoy is anchored in a suitable manner above the collecting place, and from the collecting place the oil or gas is lead to the loading buoy along a flexible piping which allows for movement of the loading buoy relative to the sea bed. Nowadays, there are few problems in transporting oil or gas from the collecting place to the loading buoy in view of the way that the loading buoy is used. With oil collection, the loading buoy may, for example, be provided with storage tanks, into which the oil pumped from the sea bed is stored before it is transported from the buoy to the vessel. However, such arrangements are complicated and expensive, and this technique is similar to using a production platform. Hence, a conventional arrangement is to use a buoy that is quite lightly constructed without any large storage tanks. In such cases the buoy normally has to be connected to a tanker, which is provided with necessary processing equipment for the preliminary treatment of the oil to separate such impurities as water and gases from the raw oil. Additionally, such a processing vessel also functions as an intermediary storage device for the oil, the oil then being pumped from this storage vessel to the transportation vessel.

As stated above, there are not nowadays many problems involved in transferring the oil from the sea bottom to the loading buoy. The main problem consists instead in transporting oil from the loading buoy to the vessel. In the most simple manner, the oil is transported from the buoy to the vessel along flexible piping floating at or near the surface of the sea. Such an arrangement, however, is only suitable for use in such circumstances where the swell of the sea or ocean is very small and the surface of the sea is virtually calm since flexible piping floating at the surface of the sea does not stand up to heavy swells and can be easily damaged. In such an arrangement, the vessel is conventionally attached to the buoy by means of cables or the like, whereby the vessel is able to move considerably relative to the buoy. Furthermore the piping floating on or just below the surface of the sea may, in heavy seas, get between the vessel and the buoy or between the attachment cables increasing even further the risk of damage. Thus, this known kind of arrangement is not suitable for oil or gas fields in which there prevails circumstances of heavy swell of the sea or ocean, such as, for example, the circumstances that exist in the North Sea. Another conventional solution for transportation of oil from a buoy to a vessel, especially in connection with loading buoys provided with storage tanks, is to attach the buoy to the vessel by means of cables or the like, and to provide the buoy with large cranes for supporting loading pipes for the oil above the surface of the sea during the loading phase. Hereby the risk of pipe ruptures is smaller than in the previous example, but a considerable drawback of this solution is the complicated and expensive structure required.

The transportation of oil from a buoy to a loading vessel has also been achieved by articulatedly attaching an intermediate boom system to the vessel, which boom system is pivotally attached to the loading buoy at its other end. Such a boom system is constructionally rigid and has a very large size, and is normally articulated to the bow or stern of the vessel by means of a horizontal articulated shaft and to the buoy by means of a vertical articulated joint. The intermediate boom also acts in such cases as a supporting element for the oil transportation piping, whereby the

piping between the loading buoy and the vessel is well protected. However, there are also several drawbacks involved in this solution. A considerable drawback is the complicated and expensive joint arrangement between the intermediate boom and the loading buoy, because in rough sea the movements of the loading buoy and the vessel relative to each other are extremely large, and they appear in many shapes. Furthermore, the articulation of the intermediate boom to the vessel limits the operation possibilities of the vessel, because such a vessel provided with an intermediate boom has normally to operate as a storage and processing vessel, from which the oil is further pumped to transportation vessels which transport the oil away from the oil field.

Previously there have been trials to avoid drawbacks caused by the swell of the ocean, water currents and the wind. As is well known, the bow and the stern of a vessel carry out extremely big and extensive movements in heavy sea, whereat there is an area in the longitudinal direction of the vessel where the movements caused by the swell of the ocean are the least. It is favourable to locate the loading arrangement at this position, because as small movements as possible are favourable in view of the anchoring arrangement and the loading. Normally this area is located about 1/2 of the vessel's overall length counted from the bow of the vessel, i.e. at the center of gravity of the waterline. Due to this, there has earlier been suggested that a loading arrangement should be fitted to the vessel at a position, which is about 1/4—1/2 of the overall length of the ship, counted from the bow. The fact that the attachment point is chosen at this position, and not at the position of the center of gravity of the waterline, is a compromise intended to provide the vessel with enough lateral surface in the backwards direction from the attachment position, in order to keep the bow against the wind. If the attachment position is located at the center area of the vessel, it is difficult for the ship to remain in a stable position without rotating around the attachment position due to the effect of the wind. On the other hand, if the attachment position is chosen as described above, a deviation of the direction of the wind will cause, with regard to the attachment position, a moment which turns the bow against the wind. In some sea regions, it is usual that the combined effect of the wind, the waves and the water currents is such that the vessel will not place itself in a favourable direction in view of the operation. Due to this, the vessel starts to move in a disturbing manner and it is necessary to use active methods, for example steering propellers, in order to keep the bow of the vessel in a desired direction. If the vessel is attached at its bow or stern, the required moment is considerably bigger than if the attachment position is close to the center of gravity of the waterline. These are the most important reasons in favour of choosing the attachment position as stated above. In known solutions there has been formed, at the aforementioned attachment position, a large-sized vertical opening, in which there has been placed an element freely rotating or mechanically rotatable around its vertical axis. Anchoring and loading arrangements may be attached to this element and the element may also be easily detachable. Even though this arrangement solves the problem caused by strong movements, a considerable drawback of the arrangement is its expensiveness. To provide existing tankers with such an arrangement, it is necessary to carry out considerable modifications of the structure of the vessel, which modifications are laborious and expensive to realize. On the other hand, to apply such a solution to a new vessel is costly and limits the further possible other uses of the vessel.

An aim of the present invention is to create a new loading arrangement, by means of which the drawbacks of the solutions of the prior art are avoided and a considerable improvement with regard to these solutions is achieved.

According to the present invention, a loading arrangement of the kind referred to is characterized in that the hull structure of the loading device is provided with supporting and attachment means in order to attach the loading device outwardly to the floating structure for the loading operation, the attachment being substantially rigid and fixed to the desired and, in view of the loading operation, most favourable position of the floating structure.

By means of the invention there are achieved many advantages compared to known solutions, among which advantages the following may be mentioned. A loading device of a loading arrangement according to the invention may be manufactured and ordered as a unit totally separate from the vessel to which it is planned to be attached to. The vessel used in the loading arrangement requires little or no modifications and so completely conventional tankers may be used for the loading arrangement. The loading device or "loading buoy" of the loading arrangement is arranged to be attached to the outside of a vessel or some other floating structure and thus may be attached at the best possible location on the floating structure which experiences the least movement in use. Due to this optimal positioning, the loading and anchoring arrangements will be subjected to a minimum of load. The vessel may be kept in a favourable position by means of as small active measures as possible. The loading device may be attached, for example, to the tanker either at an operating place located at an oil or gas field or in a harbour. By means of the loading arrangement according to the invention there

is also achieved a relatively cheap loading system compared with the prior art loading methods. This is due to the fact, that the loading arrangement according to the invention, is simple to manufacture, whereby the production costs are advantageous. The loading arrangement is favourable also in that respect since the anchoring of the loading device is easy to arrange. The loading device may be attached to the floating structure at a position where the movements of the floating structure are the smallest. This feature is important particularly in cases where the loading is difficult to carry out, for example, if the circumstances caused by the swell of the ocean are bad. Sometimes the loading has even to be interrupted due to such circumstances. Adjustment of the location and position of the vessel is, further, easy to accomplish according to the invention, because the loading arrangement may be placed in a favourable location of the vessel.

Embodiments of the invention will now be described,. by way of example, with reference to the accompanying drawings, in which

Figure 1 is a schematic cross-sectional view of one embodiment of a loading arrangement according to the invention attached to a vessel,

Figure 2 is a schematic side view of the vessel and loading arrangement shown in Figure 1 but on a smaller scale,

Figure 3 is a schematic cross-sectional view of a second embodiment of a loading arrangement according to the invention,

Figure 4 is a schematic cross-sectional view of a third embodiment of a loading arrangement according to the invention,

Figure 5 is a schematic cross-sectional view of a fourth embodiment of a loading arrangement according to the invention, and

Figures 6A, 6B and 6C are schematic perspective views of further alternative embodiments of loading devices according to the invention.

In the drawings, different embodiments of a loading device of a loading arrangement according to the invention are generally indicated by reference numeral 10. The loading device 10 is formed, as known *per se*, as a "loading buoy", which is a floating structure and which may, as shown in the Figures, be provided with ballast tanks 14, so that the vertical level of the loading device 10 in the water and relative to the water surface 28 may be adjusted when desired. The loading device 10 is provided with a connecting unit 11, which is rotatably. attached to the body of the loading device by means of bearings 12 for rotation about a substantially vertical axis. A joint 19 is provided on the unit 11 to which there is attached transportation means 20 for transporting material to be loaded from a collecting place 25 located at the bottom 26 of the sea to the connecting unit 11. When the material to be loaded is, for example, oil or gas, the transportation means 20 may be an elastic and flexible piping which allows movements of the loading device 10 relative to the bottom 26.

A loading device 10 according to the invention may also be used for collecting minerals and ores from the bottom 26 of the sea. In this case the transportation means 20 comprises a conveyor suitable for the task, which conveyor is arranged, for example, inside an elastic and flexible piping. The conveyor may comprise a screw conveyor, a conveyor operated by pressure or the like. The loading device 10 is anchored to the bottom 26 of the sea by means of anchoring chains 21, the upper ends of which may be attached to the connecting unit 11 in order to keep it almost unrotatable and as fixed as possible with regard to the bottom 26. When the loading device 10 is used for loading raw oil, the collecting place 25 is conventionally provided with necessary valve units and the like, and oil is lead to the collecting place 25 from other parts of the oil field through collecting pipes 27.

In the embodiment of Figure 1, the body of the loading device 10 is U-shaped in cross-section so that the loading device 10 comprises a generally planar lower part 33 and arms 17 and 18 directed upwardly therefrom. The loading device 10 is meant for attachment to a floating structure 30, such as a tanker, a barge or the like, and in the embodiment of Figure 1 the attachment is arranged such that the floating structure 30 is located between the arms 17 and 18 of the U-shaped loading device. The loading device 10 comprises, both at the lower part 33 of the device and at the inner sides of the arms 17 and 18, a requisite number of resting units 16 or "fenders". These units 16 may have a fixed form or may be adjustable, e.g. inflatable by means of air, and are intended to support the loading device 10 against the floating structure 10.

In the loading device 10, there is further arranged attachment means 15, by means of which the loading device 10 is attached rigidly and fast to the floating structure 30. In Figure 1, the attachment means 15 are arranged at the upper parts of the arms 17 and 12 of the U-shaped loading device 10 so that the attachment means 15 are supported to the upper parts of the boards or deck of the floating structure 30. The attachment means 15 may favourably be formed so that there is achieved a detachable attachment between the loading device 10 and the floating structure 30. For example, different bolt joints and the like are suitable for such an attachment. Necessary attachment points may be provided on the deck of the floating structure 30, to which points the attachment means 15 of the loading device are attached. The attachment means 15

may also comprise a rigid, solid attachment, for example a welded attachment, but there should normally also be arranged an emergency detachment system to the loading device 10, by means of which system the loading device 10 may be unfastened from the floating structure 30 in case of emergencies or other needs.

As shown in Figure 1, piping 13 is provided in arm 17 of the loading device 10 for transporting oil from the connecting unit 11 to feeding piping 31 of the floating structure 30. Thus, the piping 13 is well protected inside the body structure of the loading device 10. It is also advantageous to arrange required maintenance passages inside the body structure of the loading device 10, through which passages it is possible to perform the necessary maintenance work to the loading device 10, such as, for example, maintaining the bearing 12 of the connecting unit and the piping 13. The maintenance passage is hereby protected from the weather inside the body structure of the loading device 10. As can be further seen in Figure 1, the attachment between the loading device 10 and the floating structure 30 is arranged so that the loading device 10 is located centrally with regard to the floating structure 30 so that the centre line of the loading device 10 is united to the longitudinal centre line x of the floating structure 30. The stability of the loading arrangement according to the invention is considerably improved by means of such an arrangement.

Figure 2 corresponds substantially to Figure 1 but is a side view and is presented on a smaller scale. In Figure 2, the floating structure 30 is a tanker, the overall length of which is L. The loading device 10 according to Figure 1 is rigidly attached to the tanker 30 so as to be located at a distance L' from the bow of the tanker 30. The distance L' is preferably about $1/4 - 1/2 \times L$, although the loading device 10 may be attached to the tanker 30 at any desired position. However, as already mentioned above, this position, i.e. $1/4 - 1/2$ of the overall length of the tanker counted from the bow of the vessel, is a position that is most advantageous in view of the movements caused by the swell of the sea or ocean, the water currents and the wind and in view of the steering of the vessel.

In the embodiment according to Figure 2, the attachment between the loading device 10 and the floating structure 30 is further secured with the aid of attachment wires 40. The actual attaching of the loading device. 10 to the floating structure 30 is achieved by operating the ballast tanks 14 to lower the loading device 10 to a suitable depth, after which measure the floating structure 30, for example a tanker, is driven in between the arms 17 and 18 of the floating device 10. When the loading device 10 is at a suitable longitudinal position with regard to the floating structure 30, the water is pumped out of the ballast tanks 14 so that the loading device rises and the resting units 16 of the loading device 10 come into contact with the bottom and sides of the floating structure 30. Resting units 16 of different sizes may be used in the loading structure 10 so that the loading structure 10 is suitable for connection to floating structures of different sizes. When the floating structure 30 is supported by the resting units 16 of the loading device 10, the loading device 10 and the floating structure 30 are rigidly attached to each other by means of attachment means 15, and the attachment is secured by means of possible attachment wires 40. After this, the piping 13 of the loading device 10 is connected to the feeding piping 31 of the floating structure. The loading arrangement is then ready for use.

If the floating structure is a vessel in the form of a tanker 30, as shown in Figure 2, the vessel may for example, be a transportation vessel, a storage vessel, or a processing vessel. If the vessel is a storage or processing vessel, the vessel functions as an intermediate storage for raw oil and it is provided with the required equipment for the preliminary treatment of the raw oil. Another separate vessel is required for the transportation of the oil. The attachment of the loading device 10 to the floating structure 30 may be accomplished at the oil field above the collecting place 25. Alternatively the loading device 10 may be attached to the floating structure 30, for example a tanker, in a harbour, the vessel 30 and loading device then being driven to a desired place at the oil field. Detachment of the loading device 10 from the floating structure 30 is accomplished by unfastening the attachment means 15 and, if provided, the attachment wires 40, and then at least partially emptying the ballast tanks 14 to lower the loading device 10 to a suitable depth. After this the floating structure 30 is driven away from above the loading device 10. The floating structure 30 may also be attached to or unfastened from the loading device 10 so that the floating structure 30 is slid along the loading device 10 and the resting units 16 located at its surface.

In Figure 3, there is described an alternative embodiment to the solution of Figure 1. The embodiment of Figure 3 corresponds in other respects totally to the embodiment of Figure 1, but in this embodiment one of the arms 18 of the U-shaped loading device 10 is pivotally attached (i.e. articulated) to the lower part 33 of the loading device 10, the arm 18 being pivotable about a horizontal pivoting axis 35. Such a solution makes it easier to attach the loading device 10 to the floating device 30. In heavy seas a tanker 30 may have difficulties in sailing between the space between vertical arms 17 and 18 of the loading device 10, because the tolerance between the arms 17

and 18 and the boards of the vessel 30 has to stay within defined limits. In the embodiment of Figure 3, the arm 18 of the loading device 10 may be turned down about the axis 35 during attachment of the loading device 10 to the tanker 30 so that the locating of the tanker 30 above the loading device 10 is easier to achieve. When the loading device 10 is suitably positioned with regard to the tanker 30, the turned-down arm 18 is pivoted back to a vertical position, for example, by means of cranes (not shown) and wires 36, after which measure the final attachment is accomplished by means of the attachment means 15 and possible attachment wires 40, as described in connection with the previous embodiment. In Figure 3, the dashed lines show the arm 18 in a turned-down position.

In Figures 4 and 5, there are described additional embodiments of the loading arrangement according to the invention. In Figure 4, there is described a solution in which the loading device 10 is only provided with one arm 17, through which pipings 13 are lead from the connecting unit 11 to the feeding piping 31 of the vessel. In principle, the attachment and unfastening of a loading device 10 according to Figure 4 is accomplished in the same manner as in the previous embodiments. However, because this device is not provided with an arm 18, as in the embodiments of Figures 1 and 3, the loading device 10 is attached to the vessel 30 on its side opposite the arm 18 by means of attachment wires 42. The attachment may, of course, also be accomplished by other means than by use of wires 42, and one alternative may be to use a welded attachment so that the loading device 10 is welded to the lower part of the vessel 30. The attachment may also be accomplished by means of other known attachment means. In view of the attachment and unfastening, however, the attachment by means of wires 42 is to be regarded as more favourable. In this embodiment, such as also in the two previous embodiments, the loading device 10 is attached to the vessel 30 so that the centre line of the connecting unit 11 is aligned with a vertical longitudinal centre plane *x* of the vessel. By means of such an arrangement the stability of the vessel is improved, because the anchoring of the loading device 10 to the sea bed is by means of anchoring chains 21, the upper end of which are attached to said connecting unit 11.

In Figure 5 there is described still a further embodiment of a loading arrangement according to the invention. The embodiment according to this Figure corresponds in other respects to the previously described ones, but in this embodiment the loading device has no vertical arms. Instead the loading device 10 is formed by a plate-like structure, which is suitably equipped with ballast tanks 14. In this embodiment the operation of attaching the loading device 10 to a vessel 30 is achieved by first operating the ballast tanks 14 so that the loading device 10 is submerged. At the same time the loading device Is supported, for example, by means of auxiliary buoys so that it does not sink all the way to the sea bed. After this, the vessel 30 is driven over the loading device 10 and the water is pumped out of the ballast tanks 14 so that the loading device 10 rises upwards and is supported against the vessel 30 by the resting units 16. When the loading device 10 is in its correct position with regard to the vessel 30, the loading device 10 is secured in position, for example, by means of attachment wires 44. Instead of attachment wires 44 there may, of course, be used other known attachment methods, for example, a welded attachment. Because the loading device 10 of the embodiment according to Figure 5 has no vertical arms, a vertical material feeding pipe 45 centrally located in the connecting unit 11 is connected to a centrally located feeding pipe 51 at the bottom of the vessel 30. In the embodiment of Figure 5, the oil or other material to be loaded is thus pumped into the vessel 30 through the bottom of the latter. It will be realised, however, that the embodiment of Figure 5 may be modified so that the oil or the like is led from the loading device 10 to the vessel 30 along separate piping on the outside of the vessel.

In Figures 6A, 6B and 6C, there are described schematic perspective views of some alternative embodiments of a loading device 10 according to the invention. In these Figures, the loading device is described and shown in a simplified manner without attachment means 15, resting units 16 connecting units 11 or the like. The embodi-. ment of Figure 6A corresponds to the loading device 10 of Figures 1 and 2. The loading device 10 according to this Figure is U-shaped in cross-section so that the loading device 10 comprises a substantially horizontal lower part 33 and substantially vertical arms 17 and 18. In order to make the loading device 10 according to Figure 6A stable in heavy seas, the length *a* of the loading device 10 should be very large whereat the size and the weight of the loading device 10 may become unnecessarily large. The stability of the loading device 10 may be improved, without considerably increasing the size and the weight, by forming the loading device 10 in a manner describewd in Figure 6B or 6C. In Figure 6B there is described an embodiment in which the loading device 10 comprises a substantially horizontal lower part 33 having a pair of substantially vertical arms 17*a*, 17*b* and 18*a*, 18*b* at each side. Thus, in Figure 6B there are four vertical arms and, when the loading device is attached to a vessel, the two vertical arms 17*a* and 17*b* are on one side of the vessel and the two arms and 18*a* and 18*b* are on the other

side of the vessel. The attachment of the loading device 10 to the vessel is thus better and more stable than in the embodiment of Figure 6A. In Figure 6C, there is described a further embodiment of the loading device 10 in which the lower part 33 of the loading device has two vertical arms 17*a* and 17*b* on one side and a single vertical arm 18 on its opposite side. By means of such a solution, the attachment between the loading device 10 and the vessel is also firm and stable.

A common feature of all the embodiments described above is that the loading device 10 is fast with the vessel 30 during the material loading phase. This is achieved by the use of a substantially rigid attachment of the loading device to the vessel at least during material loading. Another essential feature is that the loading device 10 is attached to the vessel 30 by means of outwardly located, separate attachment means so that there is no need for any major modifications to be made to the vessel 30. Conveniently the loading device 10 is easily positionable at any desired position relative to the vessel 30. Depending on operating conditions, the loading device may thus be re-positioned to obtain the most favourable attachment position. The loading device 10 according to the invention may be manufactured, for example, of steel, whereby there may be used as producing material steel constructions generally used in marine structures. Alternatively, however, the loading device 10 may be produced, for example, of concrete, glass fibres or composite materials.

In the description above it has been presupposed that the loading device 10 is a floating structure. The loading device 10 may alternatively, however, be a non-floating structure. In this case the attachment to the floating structure may be accomplished below the surface 28, or the loading device 10 may be lifted to the surface 28 for attachment. The loading device 10 may be attached below the surface to attachment wires 44 as described in Figure 5, by means of which wires the loading device is lifted against the floating structure 30. The loading device 10 may also be lifted to the surface for the attachment phase, for example, by means of a crane (not shown) on the floating structure 30 or by means of another crane located, for example, on another vessel (not shown), and be attached to the floating structure 30 after this measure. The loading device 10 may further be supported by, for example, buoys (not shown) or the like separate from the attachment wires 44. The attachment arrangement described above may be adapted for all the embodiments described in the Figures.

The invention is not limited to the embodiments shown, but several modifications thereof are feasible within the scope of the attached claims.

CLAIMS

1. A loading arrangement intended for use in offshore locations for loading materials, such as oil, gas, minerals or the like, from the sea or the bottom of the sea to a floating structure, which loading arrangement comprises a loading device, separate from the floating structure, to which loading device the material to be loaded is arranged to be transported from a collecting or storage means, located in, or at the bottom of, the sea, along transportation means, and from which loading device the material to be loaded is further arranged to be transported to the floating structure, characterised in that supporting and attachment means are provided for attaching the loading device fast to, and at a desired position outwardly of, the floating structure.

2. A loading arrangement according to claim 1, in which the supporting and attachment means detachably attach the loading device to the floating structure.

3. A loading arrangement according to claim 1 or 2, in which the supporting and attachment means attach the loading device to the floating structure in a substantially rigid and immovable manner at least during a material loading phase.

4. A loading arrangement according to any one of claims 1 to 3, in which the loading device is arranged to be attached to the floating structure from below so that a connecting unit of the loading device, to which unit the material to be loaded is arranged to be transported from the sea or sea bottom, has a position below the floating structure substantially at the mid longitudinal plane of the floating structure.

5. A loading arrangement according to any one of the preceding claims, in which the loading device is a floating structure.

6. A loading arrangement according to any one of the preceding claims, in which the loading device is provided with ballast tanks for regulation of the floating level of the loading device and to facilitate attachment of the loading device to, and unfastening of the loading device from, the floating structure.

7. A loading arrangement according to any one of claims 1 to 4, in which the loading device is a non-floating structure.

8. A loading arrangement according to claim 7, in which the loading device is arranged to be attached to attachment means, such as attachment wires, below the surface and to be lifted by means of said attachment. means into contact with the floating structure.

9. A loading arrangement according to claim 7, in which the loading device is arranged to be lifted to the surface for the purpose of attachment.

10. A loading arrangement according to any one of the preceding claims, in which the loading device is provided with suitable transportation means for transporting material to

be loaded from the loading device to the floating structure, the transportation means being arranged within a hull structure of the loading device in order to be protected in use from the swell of the sea.

11. A loading arrangement according to any one of the preceding claims, in which the loading device is substantially U-shaped in cross-section, the floating structure being arranged to be attached between substantially vertical arms of the U-shaped loading device and to be supported by means of resting units of the loading device.

12. A load arrangement according to claim 11, in which said substantially vertical arms are arranged on each side of a substantially horizontal lower part of the loading device.

13. A loading arrangement according to claim 12, in which the or each vertical arm situated on one side of the U-shaped loading device is pivotally connected at its lower end to the lower part of the loading device about an axis designed in use to extend substantially parallel to the length of the floating structure, whereby the or each pivotally connected arm is pivotable between a turned-down position with regard to the loading device to facilitate positioning of the floating structure prior to attachment of the loading device thereto and an upper position for attachment of the loading device to the floating structure.

14. A loading arrangement according to claim 12 when dependent on claim 10, in which said transportation means is arranged within the non-pivotable vertical arm or arms situated on the other side of the U-shaped loading device.

15. A loading arrangement according to any one of claims 11 to 14, in which the attachment means connect upper parts of said arms to upper parts of the deck of the floating structure.

16. A loading arrangement according to any one of claims 1 to 10, in which the loading device is L-shaped in cross-section having a substantially vertical arm arranged to be attached to a side of the floating structure and a substantially horizontal arm arranged to be attached to the bottom of the floating structure.

17. A loading arrangement according to any one of claims 1 to 10, in which the loading device is substantially flat and is arranged to be attached to the bottom of the floating structure.

18. A loading arrangement constructed and arranged substantially as herein described with reference to, and as illustrated in, Figures 1 and 2, 3, 4, 5, 6A, 6B or 6C of the accompanying drawings.

19. A loading arrangement for use in offshore locations for loading materials, such as oil, gas, minerals or the like, from the sea or sea bottom to a floating structure, such as a tanker, barge or the like, which loading arrangement comprises a loading device, separate from the floating structure, to which loading device the material to be loaded is arranged to be transported from a collecting or storage means, located in, or at the bottom of, the sea, along flexible transportation means, and from which loading device the material to be loaded is further arranged to be transported to the floating structure, characterised in that the loading device is provided with supporting and attachment means to attach the loading device outwardly to the floating structure for the material loading operation, the attachment being substantially rigid and enabling the loading device to be attached at the most favourable position of the floating structure for the loading operation.

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